







## I-84; Echo Frontage Road, Bridge Replacement Project

### Design Perspective

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August 18, 2013




## Presentation Outline




- Existing Structure
- Bridge Description
- ABC Process and Selection
- Design Plan
- Construction Sequence
- Lateral Slide Considerations
- Risk Assessment

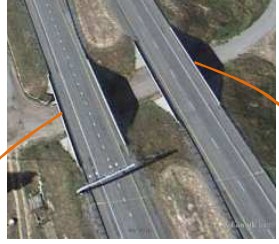
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## Existing Structure


### Location






**EB** built in median  
slid in place

**WB** built in  
place





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## Existing Structure

### Type

- 3 span cast-in-place rigid frame structure
- Steel column bents
- Pile foundations

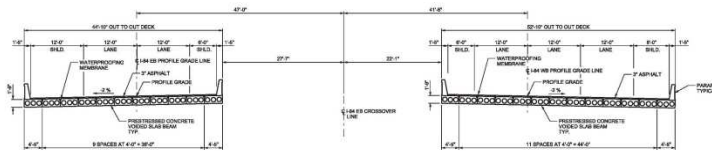





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## Bridge Description

### Superstructure



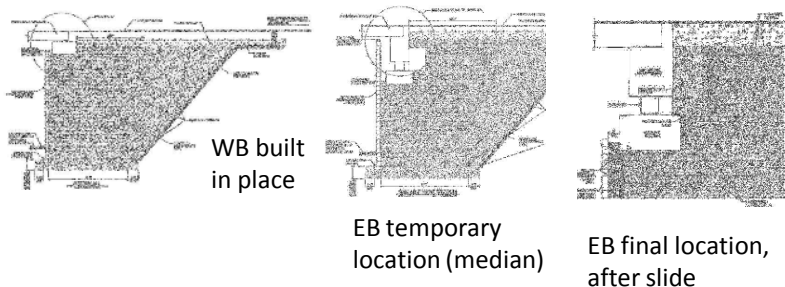
TYPICAL SECTION THROUGH STRUCTURES

- Single span bridge 57'-8" c/c supports
- 50'-0" clear span over Frontage Road
- Prestressed concrete voided beams
- Cast-in-place parapet
- 3" nominal thickness
- Asphalt overlay

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## Bridge Description

### Substructure




- Spread footings
- Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS)
  - Soil service bearing capacity = 4 ksf
  - Service max. load = 2.3 (DL) + 1.2 (LL) = 3.5 ksf

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## Bridge Description


### GRS-IBS




- Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS)
- Typical GRS – IBS beam seat, no footing
- Echo WB bridge beam seat provided footing

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## ABC Process and Selection



- Is ABC an option? Feasibility?
- What ABC method benefits the project?
  - Self-Propelled Modular Transporter (SPMT) moves
  - Lateral slides (chosen method)
  - Longitudinal launches
  - Crane based
  - Prefabricated elements (online construction)
- Why ABC (project team decision)?
  - Project schedule, environmental issues, total project cost, site conditions, indirect costs etc.

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# ABC Process and Selection Rating Procedure



Utah Department of Transportation  
4501 South 2700 West  
Salt Lake City, UT 84114

Project: Hypothetical Bridge Project  
By: JLS Checked: CGLB  
Date: 8/30/2018  
Sheet No: 1 of 3 June 2018

ABC Rating Procedure

Enter values for each aspect of the project. Attach applicable supporting data.

Average Daily Traffic  
Combined on and under: 5

Delay/Outset Time  
1: Less than 5 minutes  
2: 6-10 minutes  
3: 10-15 minutes  
4: 15-20 minutes  
5: More than 20 minutes

Bridge Classification  
1: Normal Bridge  
2: Essential Bridge  
3: Critical Bridge

User Costs  
1: No user costs  
2: Less than \$10,000  
3: \$10,000 to \$50,000  
4: \$50,000 to \$75,000  
5: \$75,000 to \$100,000  
6: More than \$100,000

Economy of Scale  
(Total number of spans)  
1: 1 span  
2: 2 to 5 spans  
3: 6 to 10 spans  
4: More than 10 spans

Use of Typical Details  
1: Complex geometry or unfavorable site conditions  
2: Some complexity, but favorable site conditions  
3: Simple geometry and favorable site conditions

Safety  
1: Short duration impact with simple MOT scheme  
2: Short duration impact with multiple traffic shifts  
3: Normal duration impact with multiple traffic shifts  
4: Extended duration impact with multiple traffic shifts  
5: Extended duration impact with complex MOT scheme

Railroad Impacts  
1: No railroad or minor railroad spur  
2: One mainline railroad track  
3: Multiple mainline railroad tracks

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4501 South 2700 West  
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Sheet No: 2 of 3 June 2018

ABC Rating Procedure

Note: Do not adjust weight factors without prior consultation with UDOT Structures Division Project Manager

ABC RATING SCORE FACTORS AND WEIGHTS

Factor	Score	Weight	Adjusted Score
Average Daily Traffic	5	10	50
Delay/Outset Time	2	10	20
Bridge Classification	1	5	5
User Costs	5	10	50
Economy of Scale	2	3	6
Use of Typical Details	1	3	3
Safety	5	10	50
Railroad Impacts	0	5	0
<b>Total Score</b>			<b>214</b>

ABC Rating Score: 214

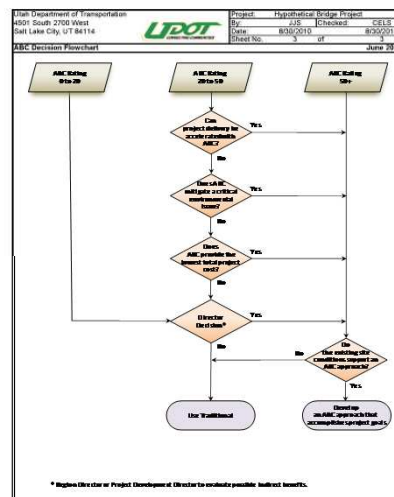
ABC Rating Score = (Total Score) / (Max. Score) \* 100  
The ABC Rating Score is given by the four most heavily weighted factors: Average Daily Traffic, Delay/Outset Time, User Costs and Safety.

Cost Considerations:  
Calculate the following costs for use in determining the lowest total project cost

	Alternative #1	Alternative #2
Construction Costs	\$2,000,000	\$3,000,000
User Costs	\$1,000,000	\$250,000
<b>Total Project Cost</b>	<b>\$3,000,000</b>	<b>\$3,250,000</b>


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# ABC Process and Selection Design Flowchart




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## ABC Process and Selection

### *ABC Method*




- Evaluation (by elimination)
  - SPMT moves (cost > \$500,000, time)
  - No launching (not feasible)
  - Crane lift (bridge wt. 800 kips, staging area, experience)
  - Prefabricated elements (time for demolition + Assembly + GRS)

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## ABC Process and Selection

### *ABC Selection*




- Selected (lateral slide)
  - Approximate cost < \$150,000 or 10% of bridge
  - Best fit for the desired MOT plan
  - Minimal traffic closure time

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## Design Plan




- Coordinate with other disciplines
- Match design with Specifications and MOT requirements
- Verify constructability with workable construction sequence
- Allow for cost effective contingencies (reduce risk)
- Utilize experienced and competent personnel
- Perform timely reviews and provide effective resolutions
- Evaluate design criteria

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## Construction Sequence

### Phase 1






- Construct EB bridge in median (temporary location)
  - Prepare ground and place GRS
  - Construct spread footing for EB bridge
  - Construct superstructure
  - Construct temporary WB roadway crossover approaches to this median bridge
  - Place asphalt overlay
  - Move/divert WB traffic to median bridge and close access to WB bridge

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## Construction Sequence



### *Phase 1; Substructure*


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## Construction Sequence

### *Phase 1; Substructure*





- CIP footing
- Precast diaphragm base
- Precast beams
- Asphalt overlay
- Left shoulders closed to traffic




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## Construction Sequence

### Phase 2




- Remove existing WB bridge structure
- Construct new WB bridge (built in place)
  - Prepare ground and place GRS
  - Construct spread footing
  - Construct superstructure
  - Build roadway approaches to new WB bridge
  - Place asphalt overlay
  - Move WB traffic from median bridge back to WB bridge (new bridge)
  - Construct temporary EB roadway crossover approaches to median bridge





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## Construction Sequence

### Phase 2; WB Bridge










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## Construction Sequence

### Phase 2; WB Bridge






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## Construction Sequence

### Phase 3




- Remove existing EB bridge structure
- Construct EB substructure
  - Prepare ground and place GRS
  - Construct spread footing
  - Build roadway approaches
  - Close EB Traffic for 27 hours
  - Slide EB bridge from median to final location
  - Complete roadway approaches, asphalt overlay and required tie-ins and open bridge to EB traffic




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# Construction Sequence

Phase 3; EB Bridge








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# Construction Sequence

Phase 3; EB Bridge









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## Construction Sequence



### *Phase 3; EB Bridge*



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## Lateral Slide Considerations


### *Time and Traffic Closure*




- One 27 hour full closure for EB Bridge slide
- Project contract time
  - 110 calendar days (winning bid by Dry Creek)
  - 120 calendar days (engineer's estimate)
  - Allowed 90 minimum and 180 maximum calendar days (per UDOT Specifications)

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## Lateral Slide Considerations




- Transpose structure
  - Elevations at temporary location match final location
- Provide redundancies
  - Strength and rigidity for slide
  - Tolerances
- Evaluate sliding methods
  - Use of rollers, sliding pads
  - Use of push/pull jacks, cables
  - Estimate of lateral control

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## Lateral Slide Considerations



- Plans
- Tolerances
- Bridge performance
- Improvements

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# Risk Assessment

## Prescriptive Over Performance

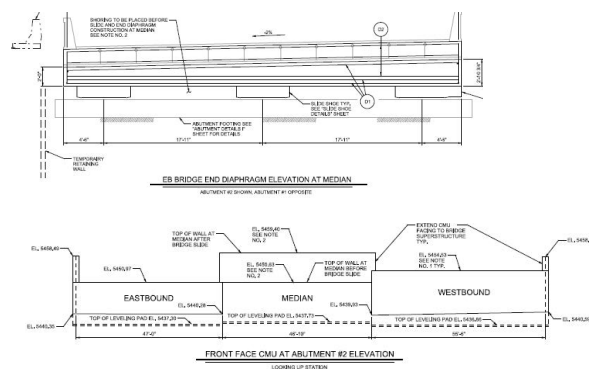


- Pros
  - Take advantage of UDOT design team experience
  - Reduce risk and ensure quality
  - Level playing field (contractor bid)
  - Provide more detail than normal
- Cons
  - Restrict contractor options
  - Require thorough understanding
- Combination
  - Add benefits to all parties

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# Risk Assessment

## Prescriptive Plans




- Slide shoe (facilitate lifting, access...)
- Level abutment (slide control, verify, construct)

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## Risk Assessment

### *Future Projects*



- Design team knowledge of available tools in the local industry
- Constructibility
- Rideability corrections
- Practical tolerances
- Monitoring plan
- Final adjustments to improve quality and performance of final structure

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## Thank you

